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SCIENCE

FRIDAY, NOVEMBER 7, 1919

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MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

A SYSTEM OF COOPERATION BETWEEN THE COLLEGE AND INDUSTRY

MUCH has been written in recent months pointing out in unmistakable terms the value of chemical research to industrial companies and organizations. There has been described an enormous number of problems within the range of chemistry and chemical engineering, which are at present confronting the industrial world or which, by their solution, would vastly enhance the efficiency of their processes or the marketability of their products.¹ Many papers have discussed the methods by which such investigational work might be introduced; some going into much detail as to the establishment of departments of chemical research within the industrial plants themselves,² and others revealing the advantages which would obtain by causing these several investigations to be studied in centralized laboratories of industrial Research.³ Still others have pointed out the advantages to the industrial organizations of permitting

¹ Duncan, "The Chemistry of Commerce," No. Amer. Rev. (1907), 241, and "Some Chemical Problems of To-day," *ibid.* (1911), 224. Hamor, "The Value of Industrial Research," *Scientific Monthly*, 1-86 (1915), and "The Research Couplet," *ibid.*, 6-319 (1917). Bacon, "The Remuneration of Industry by Research," *Sci. Am.*, 116-281 (1917). Bacon and Hamor, "Some Present-day Problems of Chemical Industry," *J. Ind. Eng. Chem.*, 11, 470 (1919).

² Mees, "Planning a Research Laboratory for and Industry," *J. Ind. Eng. Chem.*, 10, 476 (1918).

³ Bacon, "The Industrial Fellowships of the Mellon Institute," *ibid.*, 11, 371 (1919). Symposium on "An Institute for Cooperative Research as an Aid to the American Drug Industry," *ibid.*, 11, 59; 11, 157; 11, 377 (1919). Annual Report of the Honorary Advisory Council for Scientific and Industrial Research of Canada, March 31, 1919, Canadian Official Record, August 7, 1919.

some of their perplexities to be investigated within the laboratories of the college and the university.⁴

It is not the purpose of this paper to elaborate upon any of these proposed methods for the solution of the chemical research problem, nor to suggest any new solution, but rather to discuss a phase of the situation upon which but little has been said, *e. g.*, the advantages which may be derived by the college or university itself by the establishment within its department of chemistry of a co-operative system of industrial research.

It is of too common occurrence to be longer neglected that many unfortunate "diseases" are frequently encountered in the small college and university chemistry department. The members of the staff are too often fearfully overworked, and this results not only in lowering their our physical well-being and mental repose, which reflects only too plainly in the quality of the work they present to their classes, but may even result in the presentation of courses by a plan which is an imposition to the student and a discreditable reflection upon the institution.

Investigational work is often, very often, entirely excluded from the program of the instructing staff. This may be because of a lack of time, or it may be the result of indifference, but whatever the cause it is a most serious mistake. Investigational work is the one thing which is able to keep a teacher from becoming "stale" and falling into the otherwise almost inevitable "rut." A few of the leading universities in the country have set the excellent precedent of not only permitting each instructor time in which to do research but actually expecting him to do this and determining his rating to a certain extent upon his ability at research.

We often find students in their junior or senior years assisting in the instruction work in the freshman and sophomore laboratories. It is evidently necessary to do this or else to go without such assistance entirely, but it is

⁴ "Post Doctorate Fellowships," *J. Ind. Eng. Chem.*, 11, 278 (1919). "Report of the Committee on Cooperation between the Universities and the Industries," *ibid.*, 11, 417 (1919).

far from being a satisfactory arrangement. The professor is not greatly benefited, as he is obliged to keep a very close supervision over these assistants and often correct their mistakes, and the students usually fail to accept them as much more than a joke.

The average college is usually desirous of obtaining men to become candidates for advanced degrees. This is not only justifiable ambition but sound business, for on the average the men who go farthest in their study of a science while attending college as graduate students are the men who later become the recognized authorities in their respective departments. But the average college has difficulty in obtaining even a sufficient number of candidates for post-graduate work to take care of the college assistant work that is desired.

Again, many a good man would like to take advanced degree work but can not find the funds. For even if he is granted an assistantship it seldom pays more than \$300 to \$400 per year, and this is insufficient for a living. If it were made \$800 many more men would be attracted to the work.

Even the salaries of the professors themselves are often pitifully inadequate, and it becomes almost a necessity for the staff members to accept work, analytical usually, from extraneous sources in order to obtain a reasonable living income. It is evident that such work is undertaken only at the expense of the already oppressed college courses and belabored professors.

As a means of remedying some of the difficulties presented above, a properly directed system of cooperation between the college and industry has great possibilities. Such a system may be briefly drawn as follows: That industrial companies and associations shall be solicited to present their chemical problems to the college for solution.

That in consideration of a specified stipend to be paid in advance by the company or association to the college, the latter will undertake through its department of chemistry to solve such problems as may at the time be presented.

That the department of chemistry will assign a "fellow," who shall have received his bachelor's degree, to the problem; this fellow to devote from half to full time to the problem and the balance to assistant work in the department of chemistry.

That the fellow shall be paid (about) \$800 per year to be drawn from the "fellowship" fund and the college funds in proportion to the amount of time he shall spend on each.

That the work of the fellowship shall be considered as legitimate material upon recommendation of the department staff for a thesis for the degree of Master of Science, and in special cases for the degree of Doctor of Philosophy, the fellow having completed the other requisite requirements as of credits, languages, residence, etc.

That (about) 10 per cent. of the fellowship fund shall be set aside for equipment, chemicals, traveling expenses, etc.

That the several problems presented shall be under the immediate direction of the department member who represents that branch of the science, or of a director of industrial research and head of the division of industrial chemistry.

That the regular salary of each department member who has fellowships under his supervision shall be augmented by a specified sum to be drawn from the fellowship fund.

That fellows engaged upon industrial problems shall not be charged laboratory fees, or breakage fees, nor shall there be any charges relative to their procurement of any advanced degree.

That department members will not accept any personal propositions which might legitimately become a department fellowship.

The scheme as developed should relieve much of the aforementioned difficulties and "diseases."

The higher salary paid assistants would create a demand and a competition among men for the positions. High-class men may be selected. These men, being holders of at least the bachelor's degree, will be available for assistant work of a high order, such as will relieve the professors of a vast amount of responsibility and time spent in the lab-

oratory and in preparation. This alone would often cut half of the time from the professor's schedule, thus enabling him to improve his courses by giving them the proper amount of reflection and applying with deliberation the principles of pedagogy.

It will provide a suitable source of outlet for the research needs of the professor, inasmuch as he is to be the director of several fellowships. The responsibility for their success will rest primarily upon his shoulders, although the major portion of the laboratory work connected with them will be performed by others. He will thus have incentive to keep "alive," and the spirit of competition and production and contact with the outside world of industry will make him more keenly appreciative of his function as a teacher of a coming generation of chemists.

The college will be granting advanced degrees yearly to its fellows, and these are bound to create a reputation for the college in their respective fields of investigation which will make for its recognition and success.

The increase in the department personnel due to many assistants will decrease the work and responsibility of each professor, thus providing the time in which he may study and work upon his fellowship problems, and his salary will be justly augmented by inspiring work performed in working hours rather than by depressing analytical procedures performed at night or at the expense of college courses. He will not then feel the need of an apology for the profession of his choice. In brief, the college and its teaching staff in chemistry will have much to gain and nothing to lose by the adoption of a system of cooperation with industry in chemical research.

ROBERT H. BOGUE

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THE DIGESTIBILITY OF THE BRANNY COATS OF WHEAT

THERE is one phase of the recurrent subject of the digestibility of flours containing more or less of the branny portion of wheat that has not been brought out in the dis-

cussion of recent digestion experiments on bran either by Holmes¹ or Snyder.²

It is a matter of regret that Holmes did not make, or at least did not publish, the proximate analysis of the bran used in his digestion experiments. The bran is merely described as "an ordinary commercial wheat bran secured in the open market."

For the purpose of this study then we may divide the wheat berry into three portions: The germ or embryo, the branny covering and the flour cells. The branny covering includes several outer and middle layers and the inner layer termed the aleurone layer. The aleurone layer or so-called gluten cells contains proteins apparently in higher amount than the outer layers, but the gluten cells do not possess the properties of, nor take part in the formation of gluten. Hence, although functionally the aleurone layer is a part of the endosperm and serves as a covering for the flour cells or so-called starch cells or floury portion, actually the physical property it possesses of close adherence to the outer coatings during the milling process, obliges us to consider it as simply one of the bran layers. Neither the bran coats nor the germ contains starch grains or those protein bodies which possess the same characteristics as the crude gluten obtained from the flour cells by the customary mechanical method of washing away the starch from a flour dough. Nevertheless commercial bran as obtained from all processes of milling at present employed contains considerable amounts of starch and gluten. The germ is, for the most part, recovered in the shorts or sometimes as a separate fairly pure product sold as "germ middlings." Bran manufactured by large well-equipped mills making use of the most improved bran dusting machinery is less "rich" than bran made by the average mill of smaller capacity. In other words, when the bran is closely "skinned" it contains less flour than "rich" bran. The flour present in bran

exists both as loosely adhering but separate particles and unseparated masses of flour cells. No system of milling, however perfect, is at the present time capable of removing all the floury portions from the bran. Bran contains easily visible specks of flour, both free and adherent. Sometimes millers test the clean-up of their bran by rubbing it upon the coat sleeve or other piece of dark colored cloth. Commercial shorts contains still larger amounts of flour particles. White middlings, "red dog" and other "rich" feeds contain still more.

One of the tests which the cereal testing laboratory is frequently called upon to perform is the determination of the amount of flour present in bran, shorts and other by-products of flour milling. The method which we have generally used for this purpose is to determine the percentage of starch. On account of the presence in bran of considerable amounts of pentosans and other carbohydrates, the usual Sacchse method for starch determination is not applicable. The diastase method³ is usually used for this purpose. Since wheat flour contains on the average about 70 per cent. of starch, the amount of floury material or potential flour present in a wheat by-product may be determined with a fair degree of accuracy by determining the amount of starch and multiplying by one hundred seventieths. Very few samples of bran have as low as 12 per cent. of flour. The average of some recent analyses of commercial brans gave 18.93 per cent. floury material. These may possibly not be representative, but the average amount of floury material in commercial bran will not be far from 15 per cent. and 30 per cent. floury material in commercial shorts is perhaps an average amount.

Consideration of the amounts of flour in average commercial bran will throw a little further light upon the subject of the digestibility of the branny coatings in the human stomach. Bearing in mind then the percentages of digestibility found by Holmes

¹ "Experiments on the Digestibility of Wheat Bran in a Diet without Wheat Flour," U. S. Department of Agriculture. Bulletin No. 751.

² SCIENCE, N. S., 50, August 8, 1919, pp. 130-132.

³ U. S. Dept. of Agriculture, Bureau of Chemistry, Bulletin 107, p. 53.

with ordinary unground wheat bran, viz., for protein 28.0 per cent. and for carbohydrates 55.5 per cent. and the other quoted experiments on graham, whole wheat flours and straight flours where greater or less amounts of the branny coatings were present, it seems perfectly safe to assert that the digestibility of the combined branny coatings of the wheat berry is even lower than the figures quoted. If we may assume, for example, that average commercial bran contains 14 per cent. protein and consists of 15 per cent. flour cells and 85 per cent. branny coats and that average straight flour has 11.5 per cent. protein, 2.1 per cent. of the bran is flour protein and 11.9 per cent. bran protein. If it is fair to apply to the flour protein, the average coefficient of protein digestibility—90.9 per cent. found in white flour digestion experiments,⁴ 1.91 per cent. of the bran is digested from the flour protein and since but 3.92 per cent. of the total protein is digested, the balance or 2.01 per cent. represents the digestible protein derived from the bran coats only. The digestibility of the protein of the branny covering of the wheat grain is therefore about 16.8 per cent.

In the absence of data on the digestibility of ground husks and pulverized nut shells, it is perhaps no exaggeration to assert that as far as the digestibility in the human stomach of the branny portion of the wheat grain is concerned, bran must be considered as not much more nutritious or desirable than pulverized nut shells would be.

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THE INTRODUCTORY COURSE IN ZOOLOGY

It has been of especial interest to those of us in the University of Missouri who have taken part in the presentation of the introductory course in zoology to read the recent discussion

⁴ Page 6, U. S. Dept. of Agriculture, Bulletin No. 751.

in *SCIENCE* by Professor Bradley M. Davis¹ and Professor A. Franklin Shull,² because the type of course advocated by both is exactly the kind of elementary course that has been given here for nearly twenty years. It is, therefore, extremely gratifying to us to note the tendency that is beginning to manifest itself, as a result of the readjustment from war conditions, in respect to the introductory teaching of botany and zoology in our colleges and universities, and it is our earnest hope that it will not be long before the old type course will have been abandoned everywhere and its place taken by the more significant course based upon fundamental principles.

We have been attempting to do for a long time exactly what Professor Davis expresses as his hope for the future—"nothing more than the grounding of fundamental principles and a selection of information with rather definite reference to its general and practical interests, or its broad philosophical bearing," and Professor Shull's description of the first course in zoology, as it has been given in the University of Michigan for several years, applies in all essential respects to ours.

In no sense has our introductory course been one based upon the study of types, and never has it been dominated by anatomy. It has been our strong conviction that such a course fails utterly, from an educational point of view, in affording an adequate introduction to the study of zoological science. A thorough study of a single animal and studies in comparative morphology and in taxonomy belong, we have always held, to the more advanced and specialized courses designed for students who have an interest in the further pursuit of zoological knowledge, and not to the introductory course.

Long ago we recognized the obvious fact that the great majority of students who take our course in general zoology will receive no further biological training, and, therefore, our efforts have been directed toward giving it

¹ *SCIENCE*, N. S., Vol. 48, November 22, 1918, pp. 514-515.

² *SCIENCE*, N. S., Vol. 48, December 27, 1918, pp. 648-649.

significance as a factor in a general education. Throughout the course, the fundamental value of biological science to human welfare is emphasized, and no opportunity is lost to apply biological principles to the life of man. The broad, philosophical bearing of these principles is in no wise impaired by an appeal to practical interests, where such an appeal can be legitimately made.

This is the spirit behind the regulation of our college of arts and science which requires of all its students for graduation the introductory course in either botany or zoology. It seems self-evident to us that a type course does not and can not fulfill such a purpose.

General principles, not phyla and classes, furnish the *points d'appui* on which we attempt to build up both the lectures and the work of the laboratory. The animals that are used in the laboratory are studied not as representatives of groups, but rather as sample animals, convenient forms for observation and suitable for illustrating principles. Structure is never divorced from function in the instruction, and anatomical facts that fall within the scope of the course are not presented as of interest *per se*, but only as bearing upon general principles or as having some useful application.

The course is based upon the following fundamental aspects of zoological science, no one of which is unduly emphasized or slighted: (1) The organization of animals, both structural and functional; (2) the relation of animals to their environment, both general and specific (including economic considerations and relation of animals to disease); (3) the origin of the individual; and (4) the relation between successive generations of animals.

The several sections of the class are under the direction of different instructors, and each man is free to work out his own method of presentation of facts and their application to principles, but the final result and the spirit and the purpose of the course are the same throughout, although it may happen that the end is reached by somewhat different methods and arrangements of material.

The following outline, while not attempting to set forth details, fairly well represents the

general scope and nature of our introductory course.

I. INTRODUCTION. *Lectures*: (1) Definitions; scope and position of zoology among the sciences; historical background of zoological science; (2) fundamental aspects of zoology; (3) protoplasm and its properties; (4) fundamental structure and functions of animals—the cell as the unit of structure and function.

II. THE ORGAN-SYSTEMS AND THEIR FUNCTIONS. (A) *Lectures*: Based on the laboratory work on the frog, with reference, however, to other forms, including man; foods and the principles of nutrition are emphasized. (B) *Laboratory work*: The study of the organs of the frog and their functions, with numerous demonstrations and simple experiments. The concept of the animal as a cellular organism, as well as that of cell-differentiation, is built up through a study of tissues, both macerated and in section, of the frog and other animals.

III. RELATIONS TO ENVIRONMENT. (A) *Lectures*: General ecological relations; adaptations, behavior, etc., with special reference to the frog. (B) *Laboratory work*: Observations and experiments on the frog and other forms.

IV. THE PROTOZOA. (A) *Lectures*: General characteristics; structure; functions, including reactions and reproduction; relations to environment; relation to disease. (B) *Laboratory work*: Study of *Amæba*, *Euglena*, *Paramæcium*, Gregarines; observations and experiments to illustrate general principles; demonstrations of pathogenic protozoa and other unicellular organisms.

V. HYDRA. (A) *Lectures*: The study of *Hydra* as a simple metazoon and the beginning of cell-differentiation. Reproduction in the Cœlenterata. (B) *Laboratory work*: The study of *Hydra* and a hydroid colony. Demonstration of other Cœlenterates.

VI. INSECTS. (A) *Lectures*: Structure; life-histories; adaptations; habits and social relations; parasitism; insects as carriers of pathogenic organisms. (B) *Laboratory work*: The study of the grasshopper, and comparison with representatives of other orders. Numerous demonstrations illustrating protective coloration, mimicry, and other ecological re-

lations. Demonstrations of parasitic insects and other animal parasites, with explanation of relation to hosts.

VII. ONTOGENY. (A) *Lectures*: The general principles of reproduction and development. (B) *Laboratory work*: The study of the development of the frog, and comparison with other forms. Demonstrations of mitosis, germ-cells, chromosomes, fertilization; chick embryos and their nutritive mechanism; mammalian embryos and their relation to the placenta.

VIII. PRINCIPLES OF GENETICS. (A) *Lectures*: (1) Essentials of Mendelian heredity; (2) mechanism of heredity. (B) *Laboratory work*: Demonstrations of living and preserved material illustrating Mendelian principles.

IX. PRINCIPLES OF ORGANIC EVOLUTION. (A) *Lectures*: (1) Sources of evidence for evolutionary change; (2) the method of evolution, with brief historical account and a discussion in the light of recent knowledge of the manner in which evolutionary change takes place. (B) *Laboratory work*: Demonstrations of fluctuations, mutations, etc. Demonstrations of paleontological material, both fossils and models.

GEORGE LEFEVRE

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SCIENTIFIC EVENTS

CHANGES IN THE FRENCH POPULATION IN 1918

THE minister of labor has completed the birth and mortality statistics for France for the year 1918. According to the Paris correspondent of the *Journal* of the American Medical Association the statistics show that the civil population of France decreased during the year 1918 by 389,575, not counting the war losses. The statistics, based on civil records, continue to cover only the seventy-seven departments that were not directly affected by military operations. This is the same as it was during the first four years of the war. It will be the same for the year 1919, and not until the beginning of 1920 will the statistics of all French territory, made complete by accession of Alsace and Lorraine, be included.

If one compares the statistics of the years 1917 and 1918, for the seventy-seven departments of which account was taken, one will note that last year shows not only the persistence of an excess of deaths over births, but even an increase of the excess over that of the preceding year. In 1917, the population of the seventy-seven departments not invaded decreased 268,838, whereas the decrease in 1918 has risen to 389,575. This result is due to the considerable increase in the number of deaths during the second half of 1918, ascribable to the influenza epidemic; for the number of births showed a slight increase over 1917. A comparison of the statistics of the years 1917 and 1918 is given in the accompanying table:

	1918	1917
Births	399,041	343,310
Deaths	788,616	613,148
Excess of deaths over births ..	389,575	269,838
Marriages	177,872	158,508
Divorces	8,121	5,572

An analysis of the table reveals the fact that in 1918 there was: (1) an increase in the number of marriages; (2) a corresponding increase in the number of births, and (3) an increase in the number of deaths. This increase in mortality affects exclusively the second half of last year. During the first half of 1918, 316,077 deaths were recorded, as compared with 354,554 during the first half of 1917; and during the second half of 1918, 472,539 deaths were registered, as against 258,594 in 1917. According to the preceding figures, the number of civil victims claimed by the influenza last year may be placed at approximately 200,000.

A PUEBLO RUIN IN NEW MEXICO

THREE years ago Earl H. Morris, representing the American Museum of Natural History, undertook the excavation of an ancient Pueblo ruin in Aztec, New Mexico. The work was begun at the suggestion and through the courtesy of the H. D. Abrams, the owner of the property, and is being financed from the Archer M. Huntington fund for surveying the southwestern United States. During the past month the museum party has uncovered a new section of the ruin revealing several rooms filled with sand and

fallen débris. These rooms were in perfect condition, just as left by the last occupants. The ceilings were standing and the objects left by the inhabitants scattered about on the floor. Nothing has disturbed them except the fine layer of dust sifted over all. One of the rooms had been filled to the ceiling and was found to be a burial room.

Mr. Morris writes:

In two second-story chambers there was a large accumulation of dry refuse. One of these yielded some excellent specimens of textiles and a burial with wrappings in a very good state of preservation. Above the refuse in the other room there was upon the fallen third floor a surprising number of stone implements, several bone tools, some beautifully worked wooden boards, seven coiled basket plaques (three well preserved), and a digging implement with handle of wood and blade of mountain sheep horn. In the refuse beneath this layer we have to date found the burials of five children (three with wrappings perfectly preserved), four baskets in excellent shape, a wooden dipper, some beads and various odds and ends. Three fourths of the deposit is still to be gone over. The outer covering of the wrapped bodies is particularly interesting. Each body was placed upon a rush mat. Then the sides were folded inward, and one doubled upward. The whole was then tied into a long package with cord or yuca strips. As yet I have not opened any of the bundles, so do not know what the interiors may contain besides the bones. These finds certainly are important. They are different from anything we have previously uncovered.

As a result of the excavations Aztec has become a popular resort for visitors. About 100 miles southwest of the Mesa Verde Park (in which the finest cliff-houses are to be found), and not over two hours' ride from Durango, Colorado, the ruin at Aztec is an attraction to all automobile tourists. During the present year more than 1,200 people visited the ruin.

THE AMERICAN CONGRESS OF SURGEONS

THE ninth annual convention of the American Congress of Surgeons was held in New York City, beginning on October 20. War-time developments in surgery and the possibility of their adoption to industrial and civil

practise were the principal topics for discussion.

More than 2,000 surgeons were present from all parts of the United States. Major General Sir Anthony Bowlby, who served as consulting surgeon to the British forces in France; and Sir Robert Jones, chief consulting surgeon and specialist in restoration of injured limbs at the army hospitals in France, England and Ireland, were present at the meeting.

The convention was opened by an address by Dr. J. S. Hill, of Bellows Falls, Vt., president of the congress. The remainder of the day's session was given over to technical discussions. Dr. William J. Mayo, of Rochester, Minn., delivered the inaugural address on the evening of October 20, the sessions continuing throughout the week.

A series of clinics covering every phase of modern surgery, another of afternoon meetings devoted to technical discussion of the morning's work, and a program of evening sessions, which, while arranged especially for surgeons, held much of direct interest to the general public were in progress during the week. The following program was presented:

PRESIDENTIAL MEETING, MONDAY

Address of welcome, Dr. J. Bentley Squier, New York, chairman of committee on arrangements.

Address of retiring president, Dr. John G. Clark, Philadelphia.

Inaugural address, Dr. William J. Mayo, Rochester, Minn.

Introduction of foreign guests, Sir Robert Jones, Liverpool; Major Gillies, R.A.M.C., Sidcup; Sir Anthony Bowlby, London.

Sir Anthony Bowlby, K.C.B., K.C.M.G., K.C.V.O., F.R.C.S., London: "Fractures of the femur." Discussion, F. N. G. Starr, M.D., Toronto.

TUESDAY

Dr. Harvey Cushing, Boston: "Brain tumor statistics." Discussion, Dr. Charles H. Frazier, Philadelphia; Dr. Allen B. Kanavel, Chicago; Dr. Charles A. Elsberg, New York.

Dr. Alexis V. Moschcowitz, New York: "Empyema; with particular reference to its pathogenesis and treatment." Discussion, Dr. John L. Yates, Milwaukee; Dr. James F. Mitchell, Washington.

WEDNESDAY

Sir Robert Jones, F.R.C.S., Liverpool, Eng.: "Stiff and flail joints." Discussion, Dr. Joseph A. Blake, New York; Dr. John L. Porter, Chicago; Dr. Joel E. Goldthwait, Boston.

Dr. George W. Crile, Cleveland: "Surgical treatment of exophthalmic goiter." Discussion, Dr. J. Chalmers DaCosta, Philadelphia; Dr. Dean Lewis, Chicago; Dr. Charles H. Mayo, Rochester, Minn.

Dr. Otto P. Geier, Cincinnati: "The physician and surgeon in the industrial era." Discussion, Dr. John J. Moorhead, New York; Dr. William O'Neill Sherman, Pittsburgh; Dr. Jonathan M. Wainwright, Scranton; R. M. Little, Safety Institute of America, New York.

THURSDAY

Dr. John B. Deaver, Philadelphia: "The acute abdomen." Discussion, Dr. J. M. T. Finney, Baltimore; Dr. George E. Armstrong, Montreal.

Major Gillies, R.A.M.C., Sidcup, Eng.: "Plastic operations for facial burns."

Dr. C. Jeff Miller, New Orleans: "Radiotherapeutic and other methods for treatment of cancer of the uterus." Discussion, Dr. James F. Percy, Galesburg, Ill., "Cautery"; Dr. Henry K. Pancoast, Philadelphia, "X-ray"; Dr. Harold C. Bailey, New York, "Radium."

FRIDAY

Convocation of the American College of Surgeons.

Conferring of honorary fellowships.

Presentation of candidates for fellowship.

Presidential address, Dr. William J. Mayo, Rochester, Minn.

Fellowship address, Sir Arthur Bowlby, K.C.B., K.C.M.G., K.C.V.O., F.R.C.S., London.

SCIENTIFIC NOTES AND NEWS

THE National Academy of Sciences, as already announced, will hold its autumn meeting at Yale University, New Haven, on November 10, 11 and 12. Professor Henry A. Bumstead is chairman of the local committee, the other members being Professor Lafayette B. Mendel and Professor Ross J. Harrison.

IN accordance with the vote taken at the Baltimore meeting, the American Association for the Advancement of Science and the

national scientific societies affiliated with it will hold their annual meeting at St. Louis, beginning on Monday, December 29. Dr. Simon Flexner, director of the laboratories of the Rockefeller Institute for Medical Research, will preside and the address of the retiring president will be given by Professor John M. Coulter, of the University of Chicago.

THE next general meeting of the American Chemical Society will be held at St. Louis, Mo., with the St. Louis Section of the American Chemical Society, from April 13 to 16, inclusive.

THE thirty-fifth annual meeting of the Indian Academy of Science will be held on Friday and Saturday, December 5 and 6, at Indianapolis.

DR. FRANK SCHLESINGER, of the Allegheny Observatory, was elected president of the American Astronomical Society at the recent Ann Arbor meeting. Dr. Schlesinger succeeds the late Edward C. Pichering, who for many years in succession had been elected to this office.

MAJOR GENERAL W. C. GORGAS has been elected an honorary member of the National Academy of Medicine of Peru.

PROFESSOR ANTON J. CARLSON, chairman of the department of physiology at the University of Chicago, who was commissioned captain in the Sanitary Corps in 1917, made major in 1918, and lieutenant colonel in 1919, has returned to his regular work at the university. In the spring of 1919 Dr. Carlson was called to Paris and made the director of the division of the American Relief Administration known as the Children's Relief Bureau. He has since visited Poland, Czechoslovakia, Austria, Jugo-Slavia, Finland, the Baltic states and parts of western Russia, paying particular attention to putting the child-welfare work on a national and permanent basis.

HERBERT E. GREGORY, who for the past five months has been serving as acting director of the Bishop Museum in Honolulu, has returned to take up his work at Yale University.

It is announced that Dr. J. Rodríguez Caracido, the chemist and president of the University of Madrid, is a member of a Spanish delegation leaving soon for the United States.

CAPTAIN CAFFE, formerly of the Royal Air Force, left Winnipeg, Manhattan, in an airplane on October 31, to attempt the rescue of J. B. Tirrell, the geologist and mining engineer, reported to be "frozen in" and without supplies in the Rice Lake district. Attempts made to reach Mr. Tirrell by boats have been unsuccessful.

SIR BERTRAM WINDLE, F.R.S., in his annual report to the governing body of University College, Cork, announces that his resignation of the presidency of the college will shortly take effect. He has accepted an invitation from St. Michael's College in the University of Toronto to deliver a course of lectures on "Science in relation to the scholastic philosophy" during the first three months of next year.

DR. R. H. A. PLAMMER, reader in physiological chemistry, University College, London, has been appointed head of the biochemical department of Craibstone Animal Nutrition Research Institute, which is under the direction of Aberdeen University and the North of Scotland College of Agriculture.

DR. DONALD W. DAVIS, Ph.D., has returned to his position as professor of biology at William and Mary College, Williamsburg, Va. He spent the last three months of his stay overseas in research work in genetics at the John Innes Horticultural Institution.

PROFESSOR GEORGES E. DREYER, of Oxford University, delivered the first lecture at Western Reserve University School of Medicine on the H. M. Hanna Lecture Fund, on October 27, the subject being "Vital capacity and physical fitness."

UNIVERSITY AND EDUCATIONAL NEWS

It is planned to establish a post-graduate school in medicine in Western Reserve University, Cleveland, Ohio. The department is intended to offer opportunities for further

study of practising physicians who desire to acquaint themselves with current medical and surgical investigation. The course will begin next June, and is being arranged by a committee of three members of the faculty of the school of medicine. There will be short, intensive courses, without degrees, and a longer course, which will lead to the degree of A.M. in medicine. The latter is especially designed for regular students who may wish to continue their study before taking up their practise. It will be in connection with the establishment of several teaching fellowships.

LLOYD'S Register of Shipping has presented £10,000 to the fund which is being raised to establish a Degree in Commerce at the University of London.

IN the Towne Scientific School of the University of Pennsylvania, Dr. Milo S. Ketchum, has been made professor of civil engineering, he filling the post made vacant by the death of the late Dr. Edgar Marburg. He brings with him as assistant professor Dr. Clarence L. Eckel, from the University of Colorado. This department loses Dr. William Easby, Jr., professor of municipal engineering and Charles L. Warwick, assistant professor of structural engineering.

DR. A. G. HOGAN has left Kansas State Agricultural College to take the chair of biochemistry in the medical school of the University of Alabama, at Mobile. He will be succeeded at the Kansas college by Dr. J. S. Hughes.

PAUL EMERSON, Ph. D. (Iowa State), has resigned as associate bacteriologist at the Idaho Agricultural Experiment Station to accept the position of assistant professor of soils and assistant chief in soil bacteriology at Iowa State College. In that institute H. W. Johnson, M.S., has been transferred from his position of assistant in soil bacteriology to that of associate professor of soils and assistant chief in soil chemistry in humus investigations.

SINCE Fordham Medical School closed the registration in the freshmen and sophomore classes and decided to close in 1921, Dr. Carl

P. Sherwin has been transferred from the medical school, where he held a professorship in physiological chemistry, to the university. The department of chemistry in the university has been entirely reorganized with Dr. Sherwin as the head; John A. Daly and George J. Shiple are professors and Walter A. Hynes, William Wolfe and William J. Fordrungen, assistant professors.

DR. H. L. IBSEN, of the University of Wisconsin, has been appointed assistant professor of animal husbandry in charge of the courses and the experimental work in genetics at the Kansas State Agricultural College.

CHARLES HARLAN ABBOTT, Ph.D. (Brown, '18), has become instructor in zoology in Massachusetts Agricultural College.

MR. HUBERT SHEPPARD has been elected instructor in anatomy in the University of Kansas.

DR. A. E. HENNINGS, formerly professor of physics at the University of Saskatchewan, Saskatoon, Canada, and more recently assistant professor of physics at the University of Chicago, has accepted an appointment in the department of physics at the University of British Columbia, Vancouver, Canada. The departmental staff as now constituted is represented by Drs. T. C. Hebb, A. E. Hennings, J. G. Davidson and Mr. P. H. Elliott.

DISCUSSION AND CORRESPONDENCE

NATURAL FIELD SANITATION IN CHINA

IN the thickly populated parts of South China there are a considerable number of people who financially are very poor; it is a constant struggle with them to obtain food for themselves and for any live stock which they may possess, such as chickens and ducks, a few hogs, or possibly a carabao. Fuel is also very scarce and such waste vegetable matter as becomes dried is promptly utilized for heating purposes. This struggle for food and fuel leads to a prompt utilization of all waste vegetable material. Small leaves, insignificant to us for this use, are picked up sometimes one by one and it is a very common sight to see small boys and girls, too small as

yet to do heavy labor, picking up or sweeping up fallen leaves for fuel. Gardens and fields therefore are usually entirely free of old decaying vegetable material.¹ In this connection an observation upon the absence of leaf spot diseases on field crops in South China is of possible interest.

Sweet potatoes (*Ipomœa batatas*), tobacco (*Nicotiana tabacum*), turnips (*Brassica campestris*), onions (*Allium cepa*), chard (*Beta cicla*), beans (*Phaseolus* sp.), carrots (*Daucus carota*) and cauliflower (*Brassica* sp.) are commonly grown in South China. Observation of these field crops has shown them to be surprisingly free from the leaf spot diseases which would ordinarily affect these crops in the United States. These observations have been at two separate periods, at both times the weather being very moist and with temperatures which would not limit development of the causal fungi. It would seem as if these farmers in their utilization of all waste material as fuel and the consequent removal of sources of infection, maintain their crops almost entirely free from these diseases. That is, apparently the absence of leaf spot diseases may be accounted for by the field sanitation, practised unknowingly by the Chinese farmers.

These observations are put forward only as an illustration of what may be called field sanitation, carried out on a large scale with apparently successful results. This would suggest that in the United States much could be gained by more careful field methods and the

¹ Professor F. H. King in his very interesting book, "Farmers of Forty Centuries," discusses the use of compost heaps very completely. The use of compost heaps containing remnants and wastes of plant material is of course a great means for the dissemination of diseases of crop plants. Since one reading Professor King's work might consider it to refute the present suggestion, it seems well to explain that in South China such compost heaps are much more uncommon than in the region around Shanghai and Shantung province, and although compost heaps have been seen near Canton they are few and do not seem to play the part in the agricultural scheme that they do farther north.

elimination of sources of infection of crop plants.

The writer appreciates the danger of generalizing upon such a subject. However the two conditions, the one a prompt utilization of all vegetable material and the other an almost entire absence of leaf spot diseases, are both so noticeable that the coincidence and suggested explanation seem worthy of note.

ATHERTON LEE

BUREAU OF PLANT INDUSTRY

A METHOD OF IMBEDDING IN PARAFFINE

THE following method of imbedding tissues in paraffine preparatory to sectioning has proven so satisfactory in routine work in our laboratory that this brief note of description is offered.

The imbedding is done in paraffine buttons formed on the surface of cold water. Melted paraffine is allowed to flow from a pipette down the side of a glass dish with sloping wall, such as a finger bowl, nearly full of water. On reaching the surface, the paraffine hardens below, forming a button still liquid above and anchored securely at one edge to the glass. The tissue is now placed in the fluid paraffine and oriented. More paraffine may then be added to thicken the button if necessary. A label is attached by its end with a small drop of paraffine. The button is then disengaged from the glass by a dissecting needle and carried on the point of the latter below the surface. It is at once transformed to a glass of water inverted over a basin, where it remains until solid.

Large thick buttons may be obtained in this way without the use of glycerin, paper boats or frames. The rapidity with which imbedding may be done by this method is perhaps its chief recommendation.

LEO H. SCHATZ

REED COLLEGE

QUOTATIONS

SCIENTIFIC AND INDUSTRIAL RESEARCH IN ENGLAND

THE fourth annual report of the Committee of the Privy Council for Scientific and In-

dustrial Research has just been issued; it covers the period from August 1, 1918, to July 31, 1919. Earl Curzon, of Kedleston, the Lord President, records that during the past year the work of the Department of Scientific and Industrial Research has steadily grown in usefulness and in amount. The passage from war to peace, he says, reveals more and more clearly as it proceeds the need for the sympathetic encouragement and organization of research in every sphere of national life. Encouraging progress is recorded in several directions. Thus a marked change is observed to be taking place in the attitude of industry towards scientific research; both masters and men are beginning to recognize its vital importance. Something also has been done to increase the number of trained research workers, the demand for whose services rose rapidly not only in industries, but also in the universities and government departments. The report of the Advisory Council, signed by the administrative chairman, Sir William McCormick, describes in greater detail the various branches of the department's work. The work of the Food Investigation Board grew enormously during the year. The field to be covered is so large and the range of scientific knowledge so wide, that only a complex organization could hope to deal with the problems effectively. The board accordingly set up six committees to deal respectively with fish preservation, engineering, meat preservation, fruit and vegetables, oils and fats, and canned foods; and these committees have in turn appointed seven special committees. The therapeutic uses of oxygen, shown by recent practise to be capable of very great extension, and being actively investigated by the Medical Research Committee in close cooperation with the Oxygen Research Committee of the Department. The Industrial Fatigue Research Board was established jointly by the Medical Research Committee and the Department, the former being responsible for administration. The demands made upon the Board have far exceeded all anticipation, while industrial un-

rest, believed by many to be closely related to present ignorance of the laws of fatigue and the best modes of applying them in practise, has emphasized the importance of this branch of research.—*British Medical Journal*.

SCIENTIFIC BOOKS

Constructional Data for Small Telescope Objectives. Calculated at the National Physical Laboratory. By T. SMITH and R. W. CHESHIRE. 4to. Pp. 32. *Additional data for the construction of small telescopes objectives*. By the same authors. Prepared at the request of the Director General of Munitions Supplies. 4to. Pp. 82. London, Harrison and Sons, 1915 and 1916. Price, 2s. 6d. and 5s.

During the war every possible stimulus and aid was offered to manufacturers by the English government no less liberally than by our own, and of course some years earlier. The present volume is intended to save the manufacturer of small telescopes a large part of the time and expense that would be consumed in perfecting his models. British glass factories, aroused to the emergency, had succeeded in producing new varieties and a large quantity of optical glass, duplicating in feverish haste inventions evolved at leisure by German scientists and artisans during the previous thirty years. But the grinding of lenses and their combination into effective sets for binoculars, gun-sights, range-finders and photographic cameras can not be begun until protracted mathematical calculations are finished. Years of preliminary study have often gone into the making of an improved objective. One must conjecture, design, calculate and compare. Obviously, carefully systematized records of previous studies would save labor: cooperation is economy. These tables mark a new application of this principle. Glass factories supply, with a list of available melts, their indices of refraction and dispersion. By the tables one can decide quickly upon the comparative merits of doublets made from those materials.

Objectives are usually made of from two to six separate lenses. Each component by

itself gives a defective image. Rings of blue or red encircle each bright object, and in place of points of light there appear hazy circles or fantastic comet-like shapes. If at the center of the field a picture is fairly good, the parts toward the edge are distorted. To improve such crude images, at least two lenses must be used in combination. Accordingly data are here given for suitably matched two-lens objectives, one lens of crown glass, the other of flint glass, so proportioned as to eliminate at least two of the so-called aberrations, or defects of the image. The figures relate to six kinds of crown glass (a seventh in the supplement) and six kinds of flint glass. The selection of typical sorts is not made at random, nor at equal intervals in the whole range of possibilities, but near what we may call, borrowing a statistical term, "accumulation" points of the catalogue list. To suit each of six sets of conditions the proper dimensions are found for every combination of one kind of crown with one kind of flint, so that every table contains 36 entries.

The first set of tables (A) eliminates color and spherical aberration; not, of course, for all kinds of light and for objects at all possible distances, but for two different wave lengths of light and for objects at a distance so great that the rays striking the glass are practically parallel ("object at infinity"). To the removal of color from the image corresponds an algebraic equation of the first degree between the focal lengths of the two lenses, both considered as "thin"; while that for spherical aberration is of the third degree in the curvatures, or reciprocals of the radii of the spherical surfaces of the lenses. But when the two lenses are to be in contact, and their contiguous surfaces are exactly alike so that they may be cemented, the third degree equation for that common radius is reduced by one degree, to a quadratic. For this equation then there are two solutions, and so two tables of curvatures. Indeed all the pairs here tabulated are cemented lenses. Since two of the four spherical surfaces have equal radii for any desired focal length, there re-

main only two unknowns to be determined by conditions which will eliminate aberrations. For the first, our authors select color—chromatic aberration. The second condition in one case that for spherical aberration; in another, for coma; and in a third case, for equality of three radii instead of merely two. Evidently therefore this publication, though valuable as a first, is only the first among a large number of desirable thesauri for optical designers.

Of two solutions for the same physical condition, equally correct mathematically, one may prove in practise far superior. Tables *A* and *B* enable us to compare these two, both free from spherical aberration, thirty-six samples of each. To the cautious tyro, and also, it appears, to the expert, it seems better to select surfaces of small curvature where possible; although in microscopes, as Abbe demonstrated, such counsel is often misleading. Taking as unit the focal length of the combined lenses, Table *A* shows radii of curvature varying from 0.2977 to 5,000 or, for the cemented surface alone, from 0.2977 to 0.4671. The second solution, or Table *B*, shows radii for this middle surface of from 0.1705 to 0.3495. On this account therefore Table *A* gives the more useful patterns. An additional table gives for each type the amount of coma left uncorrected, which averages nearly the same for *A* as for *B*.

Both *A* and *B* are calculated for the arrangement of crown lens preceding, flint following. The reversed arrangement is provided for in Tables *E* and *F*, and these call for radii which are individually and on the average considerably smaller, curvature therefore greater; but in *E*, the coma remaining in the system is somewhat reduced. Other tables are for forms where three radii are equal and the fourth surface nearly flat, so that the cost of grinding might be lessened even though the telescope would be less efficient. These last are accompanied by an exhibit of the residual amount of both spherical aberration and coma. Two further tables promise freedom from coma, with stated amounts of uncorrected spherical aberration.

So far, it has been assumed that the thickness of the lenses is so small as to be negligible. Of course the diameter that is needed for a particular purpose may cause a thickness which is far from negligible, especially in types having one or more fairly large curvatures. To allow for this, the authors fix arbitrarily a "standard thickness" of one-fortieth the focal length for a convex lens, one eightieth for a concave, and furnish for these standards thicknesses tables of two sorts. The first shows how much the focal length is diminished by standard thickness when one uses the radii taken from a thin-lens table, and the second shows by what amount the curvature of the fourth surface (the most nearly flat) may be modified to restore the focal length to its intended value, unity.

Such an alteration of one surface is however only a make-shift, as is seen from the later tables (1916), "Additional data," etc. To alter the curvature of a single one of the four surfaces disturbs not only the focal length, but also the precise balance of both the aberrations which are already eliminated. The authors recommend it indeed only when the focal length is to be short. Otherwise it is necessary to change slightly all three curvatures from the 1915 tables. Very full information is given as to the amount of change. First they give factors for interpolation when either index differs slightly from that for which the earlier tables were computed. Then back to this table are referred, in the next following series, the effects of standard thickness upon chromatism. Namely, the corresponding change to be made in the ratios of indices for flint and crown is stated, so that by two tables the changes of curvatures can be found. Next comes the effect upon spherical aberration resulting from standard thickness, and last, the necessary changes in curvatures to correct that error. But it is recommended that when two kinds of aberration simultaneously become serious in amount, the curvatures be computed entirely *de novo*, since the errors are not wholly independent. Such computation is of course greatly facilitated by knowl-

edge of any approximate values for the radii; and this constitutes one of the chief reasons for expecting these tables to prove generally serviceable.

The authors deserve the thanks of optical computers further, in particular, for their care in testing results by trigonometrical calculations. Judging from more than a hundred such verifications, they inform us, the small errors in the approximate values of spherical aberration occur only in the fourth decimal place, so that they would hardly influence the specifications to be given to the mechanician. The data in the first tables run to three decimal places.

Of major significance are the graphs, pages 80 and 81, showing the performance of typical lenses of the various types at different apertures. Group A makes quite the best showing. The final page, with some general conclusions, may well be read first.

American readers will have noticed already, from certain reports published by the Bureau of Standards, that projects not wholly dissimilar to this have been under consideration, and are already partially realized, for lightening the arduous labor of finding satisfactory first approximations in definite types of lens design.

HENRY S. WHITE

BUREAU OF STANDARDS

SPECIAL ARTICLES

ELECTROLYTES AND COLLOIDS

THE effect of ions on the physical properties of proteins is one of the most interesting chapters of colloid chemistry. The work on this topic quoted in the textbooks of colloid chemistry suffers from two sources of error, namely, first, that the effect of the hydrogen ion concentration is generally ignored, and second, that the effect of the nature of ions on the physical properties of proteins is often ascertained in the presence of an excess of an electrolyte. Proteins are amphoteric electrolytes and therefore occur in three states according to the hydrogen ion concentration, namely as: (1) protein, free from ionogenic impurities, (isoelectric protein); (2) metal proteinates, *e. g.*, sodium proteinate or cal-

cium proteinate, etc.; and (3) protein acids, *e. g.*, protein chloride or protein sulfate, etc. For gelatin the hydrogen ion concentration defining the isoelectric point is, as Michaelis¹ first showed, about 2×10^{-5} N (or in Sørensen's logarithmic symbol $\text{pH} = 4.7$). At this hydrogen ion concentration gelatin can practically combine with neither anions nor cations of an electrolyte. When the hydrogen ion concentration becomes lower than 2×10^{-5} , *e. g.*, through the addition of NaOH, part of the isoelectric gelatin is transformed into sodium gelatinate, and the relative amount of isoelectric or non-ionogenic gelatin transformed into sodium gelatinate increases with the diminution of the hydrogen ion concentration. Sodium gelatinate can exchange its cation with the cation of neutral salts but is not (or practically not) affected by the anion of a neutral salt. When we raise the hydrogen ion concentration of gelatin solutions above that of the isoelectric point, *e. g.*, by adding HCl, isoelectric gelatin will be transformed into gelatin chloride and the transformation will become the more complete the higher the hydrogen ion concentration, until finally all the isoelectric gelatin is transformed into gelatin chloride. The gelatin-acid salts can exchange their anion with the anion of other salts but are not (or practically not) affected by the cation of other salts.²

While isoelectric gelatin has a minimal osmotic pressure, a minimal power of swelling, a minimal viscosity, a minimal transparency, a minimal alcohol number, etc., gelatin salts, *e. g.*, sodium gelatinate or gelatin chloride, have a high osmotic pressure, a high power of swelling, a high viscosity, etc. The writer has been able to show by volumetric analysis that the osmotic pressure, the power of swelling, etc., of gelatin increase with the relative amount of isoelectric gelatin transformed into gelatin salt.³ The physical properties of gelatin, *e. g.*, its

¹ Michaelis, L., "Die Wasserstoffionenkonzentration," Berlin, 1914.

² Loeb, J., *J. Gen. Physiol.*, 1918-19, I., 39, 237.

³ Loeb, J., *J. Gen. Physiol.*, 1918-19, I., 237, 363, 483, 559.

osmotic pressure, depend therefore not only upon the concentration of the gelatin in solution but also upon the hydrogen ion concentration.

Colloid chemists usually state only the amount of acid added to a protein without measuring the hydrogen ion concentration of their protein solution. The effect of the addition of the same amount of acid upon the chemical and physical properties of gelatin is entirely different according to the hydrogen ion concentration of the gelatin used. When a slight amount of acid is added to isoelectric gelatin it will increase its osmotic pressure while the same amount of acid if added to gelatin with a $\text{pH}=3.3$ or to neutral gelatin ($\text{pH}=7.0$) will diminish its osmotic pressure. Since the hydrogen ion concentration of commercial gelatin varies and since, moreover, the combining power of different acids with gelatin varies also,⁴ the results obtained by the addition of electrolytes without measurement of the hydrogen ion concentration are irregular and confusing.

In addition, the properties of gelatin salts depend upon at least two more variables, namely, the nature of the ion in combination with the gelatin and the concentration of electrolyte present. When we transform 1 per cent. solutions of isoelectric gelatin into sodium gelatinate and calcium gelatinate both possessing the same hydrogen ion concentration (*e. g.*, 10^{-9}) the sodium gelatinate has an osmotic pressure more than twice as great as the calcium gelatinate. This difference is not due to a difference in the degree of electrolytic dissociation since both solutions have the same conductivity.⁵ When we add increasing quantities of neutral salts or alkalies to the two solutions the osmotic pressure is depressed in both solutions and if enough is added the osmotic pressure falls to almost zero in both solutions. (If we add acid, the same will occur but for another reason, the metal gelatinate being brought to the isoelectric point, and, by addition of more

acid, being transformed into gelatin-acid salts.)

The same difference as between sodium and calcium gelatinate exists between gelatin chloride and gelatin sulfate⁴ and this difference is also obliterated when neutral salt or acid is added to the solution. (The addition of an excess of alkali would transform the gelatin acid into isoelectric gelatin and finally into metal gelatinate.)

If we wish to investigate the specific effect of different ions on the physical properties of gelatin (or of proteins in general) it is therefore necessary to avoid an excess of electrolytes. The writer proceeds in the following way. Finely granulated (commercial) gelatin is brought to the isoelectric point by the method described in the writer's previous publications. Isoelectric gelatin if properly washed will lose its ionogenic impurities. Just enough acid or alkali is then added to 1 gm. of isoelectric gelatin to produce a gelatin salt (either gelatin acid or metal gelatinate) of the desired hydrogen ion concentration. Since there exists an equilibrium between free acid (or free alkali) gelatin salt and isoelectric (non-ionogenic) gelatin two solutions of metal gelatinate (*e. g.*, Na gelatinate and Ca gelatinate) each containing 1 gm. of isoelectric gelatin and each possessing the same hydrogen ion concentration contain the same proportion of metal gelatinate and non-ionogenic gelatin. Differences in the physical properties of these two solutions may be ascribed to differences in the effect of the metal ion in combination with the gelatin. The same is true for solutions of gelatin chloride and gelatin sulfate of the same hydrogen ion concentration if prepared from isoelectric gelatin of the same concentration. If this procedure is not followed, erroneous results will be obtained such as are found in the textbooks of colloid chemistry. Thus it is generally stated that acids and alkalies increase the osmotic pressure of gelatin while neutral salts depress it. This statement is entirely wrong and due to the fact that the experimenter responsible for this statement did not work with gelatin

⁴ Loeb, J., *J. Gen. Physiol.*, 1918-19, I., 559.

⁵ Loeb, J., *J. Gen. Physiol.*, 1918-19, I., 483.

solutions standardized according to the method just described. Correct and constant results can only be obtained if such a method of standardization is used.

Another error which permeates the literature of colloid chemistry is due to Hofmeister's experiments on the influence of different ions on the swelling of gelatin. Hofmeister's experiments were all made in the presence of an excess of electrolyte, in which the specific effect of different ions can no longer be recognized. When we prepare sodium and calcium gelatinates or gelatin chloride and gelatin sulfate according to the writer's method and put them into distilled water we find that the sodium gelatinates swells considerably more than the calcium gelatinates and that the gelatin chloride swells considerably more than the gelatin sulfate of the same concentration of isoelectric gelatin and of hydrogen ions. If, however, we add neutral salt or alkali to the two solutions of metal gelatinates or neutral salts or acid to the solutions of gelatin chloride and gelatin sulfate the differences in swelling disappear since in all cases the swelling is repressed. It is only necessary to add enough electrolyte so as to make the solution M/4 or even less to completely mask the differences. The writer feels therefore justified in stating that if we wish to compare the effect of different ions on the physical properties of gelatin we must avoid the error of adding an excess of electrolyte to the solution.

A writer⁶ in *Nature* has raised the objection that Sørensen's experiments on the osmotic pressure of egg albumin were done in the presence of ammonium sulfate, but he overlooks the fact that Sørensen's experiments⁷ were not concerned with the comparison of the effect of different ions on the osmotic properties of egg albumin. If it had been Sørensen's intention to compare the osmotic pressure of albumin chloride with that of albumin sulfate or of sodium albuminate with that of calcium albuminate he

would have found it necessary to take cognizance of the fact that the specific effects of different ions on the physical properties of gelatin (or possibly of proteins in general) are repressed in the presence of an excess of electrolyte. As far as the writer is aware there is no disagreement between his results and views and those of Sørensen, though there is a difference in the method employed and the nature of the protein used.

The writer's recent experiments seem to indicate that the specific influence of the nature of ions as well as the depressing effect of an excess of electrolyte on the physical properties of colloids are connected with the electrification of water, and that this connection seems to be the same in the case of crystalloidal and of colloidal solutions of electrolytes. Since it would exceed the limits of this note to discuss these observations, the reader interested in this feature of the problem is referred to the writer's publications on the subject in the current numbers of the *Journal of General Physiology* and the *Proceedings of the National Academy of Sciences*.⁸

JACQUES LOEB

THE ROCKEFELLER INSTITUTE
FOR MEDICAL RESEARCH,
NEW YORK

THE AMERICAN CHEMICAL SOCIETY.

II

DIVISION OF PHARMACEUTICAL CHEMISTRY

F. O. Taylor, *Chairman*

George D. Beal, *Secretary*

A new field of phytochemical research opened up by the cultivation of medicinal plants on a semi-economical scale: EDW. KREMERS.

Some of the characteristic toxic principles of western poisonous plants: O. A. BEATH.

A comparison of several methods for estimating quinine and strychnine when occurring in the same solution: A. R. BLISS, JR.

Quantitative determination of mercury: SIGMUND WALDBOTT. Precipitate the mercury from dilute solution completely on copper foil, dry and weigh the latter, then expel the mercury by holding the foil above a flame until the gray film has

⁶ *Nature*, 1919, CIV. (September 4), 15.

⁷ Sørensen, S. P. L., *Compt. rend. trav. Lab. Carlsberg*, 1917, XII.

⁸ Loeb, J., *J. Gen. Physiol.*, 1918-19, I., 717; 1919-20, II., 87.

just disappeared, then weigh the foil again. The difference in weight is due to the volatilized mercury. In one instance, 99.83 per cent. of Hg was recovered from HNO_3 solution.

The U. S. P. assay of Donovan's solution: SIGMUND WALDBOTT. The U. S. P. assay of a certain well-prepared Donovan solution gave far too low results in mercuric iodide contents. Preliminary experiments indicated that the two-fold step in the U. S. P. determination of mercury involved some loss. A simple method for the determination of mercury in Donovan's solution is proposed, as follows: Precipitate 25 c.c. of Donovan's solution with excess of freshly prepared ammonium sulphide solution, decant and filter through a double filter, wash, dry at 100°C . and weigh, the two filter papers being previously counterpoised. Two determinations gave satisfactory results.

The theory of emulsion making: W. D. BANCROFT.

DIVISION OF WATER SEWAGE AND SANITATION

Robert Spurr Weston, *Chairman*

W. W. Skinner, *Secretary*

Determination of iodid and bromid in mineral waters and brines: W. F. BAUGHMAN and W. W. SKINNER.

The determination of bromid and iodid in mineral waters and brines: H. H. WILLARD and C. C. MELOCHE. The iodid is oxidized to iodate by adding to the neutral solution of salts a considerable excess of permanganate and boiling for a moment. The solution is cooled, a small amount of hydrochloric acid is added, more than enough to liberate all the bromin and a current of air passed through the hot solution to remove all bromin which is collected in sodium hydroxide, reduced to bromid, precipitated as mixed silver chlorid and bromid, fused, weighed, fused in chlorin and weighed again. From the loss in weight the amount of bromin is calculated. The residue in the retort is treated with alcohol to reduce the excess of permanganate, and the manganese dioxide filtered off. To the filtrate potassium iodid is added then excess of acid, and the iodine liberated is titrated with thiosulfate.

The removal of colloidal silicic acid and clay from natural waters: OTTO M. SMITH.

A study of well water in a rural community: G. O. HIGLEY. This study was begun because of the fact that the death rate from typhoid in Delaware County was 25.2 per 100,000 of population, as against 6.9 for Cuyahoga County (Cleveland) and

3.9 for Hamilton County (Cincinnati). The writer with assistants personally visited about 675 homes, noted the condition of the well and surroundings, talked with the people, emphasizing especially the danger if human excreta finds entrance into well water, and took a sample of water in a sterilized bottle for analysis. The tests made were the lactose broth and the chlorid tests. About 40 per cent. of the water from dug wells was found polluted. As the eastern half of the county is underlain with shale, and the western half with limestone it was thought that the degree of pollution of well water might be found markedly different in the two sections; however the work is still too incomplete to warrant any report on this point.

Field methods for the chlorination of small amounts of water: F. R. GEORGIA. This paper describes conditions of water supply prevailing in the area occupied by the First Depot Division in France. Various methods and devices are described and illustrated for the continuous chlorination of small supplies of water. Some of these devices were constructed in the field from materials at hand. The Lyster bag for water sterilization is described and methods for its use and control are discussed. Tabulations of the bacteriological results obtained are given.

The electrostatic precipitation of dust as applied to the sanitary analysis of air: J. PENTEADO BILL. An apparatus was devised for producing a rectified alternating current of about 20,000 volts. The collector is a 12-inch piece of aluminum tubing, $2\frac{1}{2}$ inches in diameter, through which air is drawn by a motor at the rate of 273 cubic feet per hour. Seventy-one tests, each of one hour's duration, were made with this apparatus and a Palmer water spray sampler in the various buildings and departments of a large plant making rubber goods. The following determinations were made for each test: Relative and absolute humidity, barometric pressure, weight of total sediment in 50 c.c. sample of 100 c.c. aqueous suspension of particles collected in both machines, weight of organic and inorganic fractions of each 50 c.c. sample, the weight of the aluminum collector before testing, with its accumulated dust charge, and with the dust portion still retained after rinsing out to make up a 100 c.c. aqueous suspension. Counts were made on each suspension. The high tension weight figures were reduced to figures comparable with the rate of air passage through the Palmer machine. The resulting figures when compared with the weight figures of the Palmer determinations, together with a comparison of the

counts made on both Palmer and high tension suspensions, showed, on a percentum basis, that the Palmer apparatus collected 59.9 per cent. of total particles counted in the high tension suspensions; 63.3 per cent. of the total sediment, 66.6 per cent. organic portion, and 55.2 per cent. inorganic portion collected by the electrical machine. Based on total sediments collected per 240 cubic feet of air in each process whose air was sampled, the Palmer collected 63 per cent. of the amount retained by the electrical method. The conclusions are that the Palmer apparatus under similar conditions is 61.6 per cent. as efficient as the electrical method (average of above figures). The electrical apparatus used is too bulky for ordinary field work, and suggestions are made for its simplification. It is felt that the findings warrant further study of the electrical precipitation method as applied to the sanitary analysis of air.

DIVISION OF PHYSICAL AND INORGANIC CHEMISTRY
W. E. Henderson, *Chairman*
W. A. Patrick, *Secretary*

The vapor pressures of mercury in the range 120° to 250°: ALAN W. C. MENZIES. Two McLeod gauges containing dry hydrogen over pure mercury were connected with the same pressure reservoir. One of the gauges was raised to the desired temperature and both gauges then operated simultaneously. The vapor pressure of mercury was calculated from the difference, due to mercury vapor, of the pressure readings given by the hot and the cold gauges respectively.

The vapor pressure of tetranitromethane: ALLAN W. C. MENZIES. These measurements covered the range 40° to 126°, thus including the solution of War Problem No. 142 of the National Research Council. The entropy of vaporization of this liquid appears to be normal.

Production of hydrochloric acid from chlorine and water: H. D. GIBBS.

Opening up minerals with phosgene: CHARLES BASKERVILLE. The bleaching of ferruginous silicious bricks by the action of phosgene in plants where that poisonous gas was manufactured has been noted. The useful application of this method of conversion of iron oxides into volatile ferric chloride, with a bleaching, for glass-sand, was suggested by Hulett. Phosgene under the influence of heat is very reactive at temperatures of 450° C. and above. We have converted oxides of aluminum and cerium, insoluble in acids, oxides of zirconium and thorium, insoluble in acids except

boiling concentrated sulphuric acid, directly into water soluble chlorides or oxy-chlorides. Bauxite and carborundum yield ferric and aluminum chlorides. Zirconium chloride has been distilled from zircon (silicate), ferric chloride from the contaminating iron being fractioned away due to its greater volatility. The silica remains behind. Thorianite yields soluble thorium and uranium chlorides. The procedure is very simple. The pulverized material is heated in a quartz tube in a stream of gaseous phosgene. It is proposed to extend the work to a large number of the rare-earth minerals.

The preparation of colloidal gold and silver by new reducing agents: HARRY N. HOLMES.

Phase rule studies of the nitrotoluenes: C. H. HERTY, JR.

Compression by adsorption: WILLIAM D. HARKINS and D. T. EWING.

The work done by the attraction between a mercury surface and the surface of an organic substance: W. D. HARKINS, E. H. GRAFTON and D. T. EWING.

The change of molecular kinetic into molecular potential energy: WILLIAM D. HARKINS and L. E. ROBERTS.

The separation of yttrium from the erbium earths: P. H. M. P. BRINTON and C. JAMES.

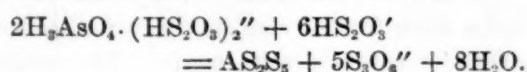
A new method for the determination of zirconium: M. M. SMITH and C. JAMES.

The effect of lead upon thorium nitrate in aqueous solution: FANNY R. M. HITCHCOCK.

An electrometric study of the neutralization of monocalcium phosphate: GERALD WENDT, A. H. CLARKE and S. M. WEISMAN.

The existence of an ozone form of hydrogen: GERALD L. WENDT and ROB. S. LANDAUER.

Action of thiosulfate on arsenate in acid solution: GEO. SHANNON FORBES and O. J. WALKER. Thiosulphate in excess precipitates As_2S_3 from H_3AsO_4 in HCl (Vortmann, 1889). We combined reactants, varying one concentration at a time, and plotted S_2O_3/H_3AsO_4 against HCl/H_3AsO_4 for incipient precipitation. Given one concentration constant, any curve has a horizontal part along which $S_2O_3/H_3AsO_4 = k = 2$, meeting a nearly vertical part when $HCl/H_3AsO_4 = 2$. This indicates a complex, $H_3AsO_4(HS_2O_3)_2$, but its average hydrogen content decreases with increasing S_2O_3 . Trithionate, with thiosulphate, accompanies As_2S_3 along the "vertical" lines.



Pentathionate, with sulphite, accompanies As_2S_5 along the horizontal lines.



Specific heat determinations with an adiabatic calorimeter: FARRINGTON DANIELS and CHARLES B. HURD.

The partition of metallic radicals between a salt phase and an alloy phase: HERBERT F. SILL.

The retention of bromine by silicic acid gel: W. A. PATRICK and E. L. RYERSON.

Determination of the viscosity of pyroxylin solutions: E. F. HIGGINS and E. C. PITMAN.

A slide rule for special cases: F. C. BLAKE.

Adsorption by precipitates. (II.), the adsorption of anions by hydrous ferric oxide: HARRY B. WEISER and EDMUND B. MIDDLETON.

The physical character of hydrous ferric oxide: HARRY B. WEISER.

Flame reactions of selenium and tellurium: HARRY B. WEISER and ALLEN GARRISON.

The catalyst in the oxidation of ammonia: G. A. PERLEY.

Equilibria in the systems: carbon disulfide, methyl alcohol and carbon disulfide, ethyl alcohol: E. C. MCKELVY and D. H. SIMPSON. The mutual solubility relations of the two pairs of liquids were determined over practically the whole range of concentrations paying particular attention to the purity of the materials used. The following values were obtained for the critical solution temperature and the critical concentration: for methyl alcohol—carbon disulfide + 35.7°, 84.7 per cent. CS_2 ; for ethyl alcohol—carbon disulfide — 24.4°, 82.7 per cent. CS_2 ; applications to the determination of small quantities of water in the alcohols and the analysis of anhydrous methyl and ethyl alcohol mixtures were pointed out.

Notes on the estimation of nitrates and nitrites in battery acids: LILY BELL SEFTON.

A metal to glass joint and some of its applications: E. C. MCKELVY and C. S. TAYLOR.

Fluorides of cobalt, nickel, manganese and copper: F. H. EDMISTER and H. C. COOPER. The fluorides of cobalt, nickel, manganese and copper can be prepared by dissolving the hydroxide or the carbonate of the metal in hydrofluoric acid, the same product being obtained, whichever is used. In all cases a crust-like product was obtained. By recrystallizing from water, slightly acidulated with hydrofluoric acid, crystals of the acid fluorides were formed and analyses and measurements of these crystals were made. The analyses indi-

cated that these salts all form an isomorphous series but the crystallographic measurements showed that only the cobalt, nickel and manganese salts are isomorphous, while the copper salt belongs to a different system. The formulas of all four fluorides are of the same acid fluoride type: $\text{MF}_2 \cdot 5\text{HF} \cdot 6\text{H}_2\text{O}$. It was surprising to obtain the acid fluoride by recrystallization from water, a basic salt being expected under these conditions. These acid fluorides are not permanent in the air but decompose, losing hydrogen fluoride and, in the case of copper, losing water also, so that the crystals used for analyses must be carefully selected. The formation of a hydrated, non-crystallized crust is distinct from that of the hydrated acid fluoride crystals. In this crust the ratio of metal to fluorine, for the cases of cobalt and nickel, was found to be about one to two, with varying water content. This crust differs from the crystals in solubility and form, as well as in composition. We have arrived at the conclusion that the crust described by Berzelius as containing two molecules of water, the crust later described by Clarke as containing three molecules of water, and the crust and powder obtained by us are the same, the water content being variable and the crystal form being undeveloped. All were obtained in the same manner.

The determination of mercury: H. B. GORDON.

The preparation and uses of TiCl_3 solution: F. L. ENGLISH and H. S. TANNER.

Contrasting effects of sulfates and chlorides on the hydrogen ion concentration in acid solutions: A. W. THOMAS and M. E. BALDWIN.

Chromophor tautomerism in indicators: WILLIAM C. ARSEM.

CHARLES L. PARSONS,
Secretary

(To be continued)

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